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The effect of coupling agents (maleic anhydride) in polypropylene

Abolfazl Heydari[1], Gholam Hossein Zohuri[*] [1], Mohammad Reza Rahmani [2], Mitra Bahramian[2]

[1]Department of Chemistry, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran.

[2]Talayeh Industria Complex , Mashhad, Iran.

[*]E mail: zohuri@um.ac.ir

Abstract: Polypropylene composites was made within two different type of fillers and a coupling agent to improve its mechanical properties. The composite was used for injection process. Injection temperature, injection pressure, injection speed, injection pause time, cooling time and all conditions of the composites were controlled accurately. Mechanical properties of charpy impact strength, tensile strength, elongation to break and hardness are studied. Composites of PP/Talc (10%) and PP/$CaCO_3$ (10%) were selected as combinations due to having the optimum of the mechanical properties. A ternary composite of PP (90%)+Talc(5%)+ $CaCO_3$ (5%) which was studied show an impact strength as high as the pure PP. To improve the mechanical properties of the composite a maleic anhydride grafted polypropylene copolymer was used which unfortunately showed a negative effects on the mechanical properties, particularly on impact strength, the most important factor of the project. To improve the effect of maleic anhydride (1 w% to 5 w%) as a suitable coupling agent, was added to the composites. Impact strength of the composite was increased as much as 100 percent compare to PP/Talc (10%) and PP/$CaCO_3$ (10%) composites and 20 percent increases compeer to PP itself.

Keywords: polypropylene, polypropylene composite, coupling agent, maleic anhydride.

Introduction

Polypropylene (PP) is one of the most important common plastic as it has an excellent balance of mechanical properties such as, melt flow, chemical residence, moisture barrier properties together with its low cost, availability and possible addition of mineral fillers [1-3]. Polypropylene was reinforced with a talc ($Mg_3Si_4O_{10}(OH)_2$) additive and following to addition of a coupling agent to improve its impact strength and reduction of the price. Talk as an effective mineral filler is the most useful additive which is compatible with PP [4,5].

Experimental/ Theoretical

Talc, calcium carbonate and maleic anhydride were purchased from Kian Chemy, Mashhad, Iran, were used as fillers and coupling agent respectively. Due to benefit of talk compare to $CaCO_3$, talk was preferred to use. To demonstrate the effect of maleic anhydride as a suitable coupling, maleic anhydride (1 w% to 5 w%) was added to the composites (Talc (10%-40%)/PP). Due to the optimal of mechanical properties obtain of PP(90%)+Talc(10%) composite, was selected for further study.

Results & Discussion

Mechanical properties of the composite such as impact strength, as main target, tensile strength and elongation at break were investigated. Addition of 10 w% of talk to PP cause a drop of 50% of in impact strength compared to the polypropylene itself. However, addition of malic anhydride (only percentage 3 w%) shows an increases in impact strength (18%) compared to the polypropylene and increases (100%) compared to PP (90%) + Talc (10%) composite (Fig 1). Both of the tensile strength and elongation at break, also, were increases (15.5-17.9 mPa) and (31.4-68.3%) (Table 1).

Table 1 effect of addition of malic anhydride of mechanical properties.

composites	Impact strength(kJ/m²)	tensile strength(mPa)	elongation at break(%)
PP+10% Talc	71.25	15.5	31.4
PP	128.9	17.5	44.5
PP+10% Talc+ 3% maleic anhydride	152.21	17.9	68.3

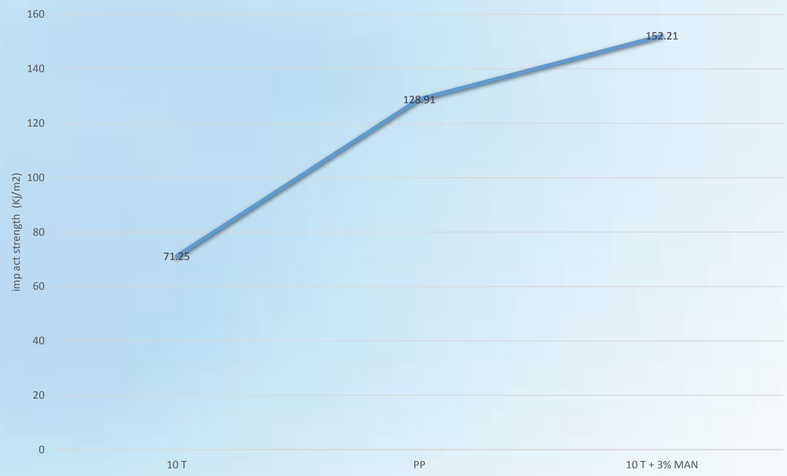

Fig 1 variation of impact strength of the composites.

Conclusion

Malic anhydride shows an effective coupling agent of the PP composite with additives such as talk which increase its mechanical properties and not so much affected on its cost.

acknowledgment

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